5. Total Maximum Daily Loads

A TMDL prescribes an upper limit on discharge of a pollutant from all sources to assure water quality standards are met. It further allocates this load capacity (LC) among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a waste load allocation (WLA); and nonpoint sources, which receive a load allocation (LA). Natural background (NB), when present, is considered part of the load allocation, but is often broken out on its own because it represents a part of the load not subject to control. Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (40 CFR part 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the MOS is a reduction in the load capacity that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the load capacity available for allocation to human made pollutant sources. This can be summarized symbolically as the equation: LC = MOS + NB + LA + WLA = TMDL. The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First, the LC is determined. Then the LC is broken down into its components: the necessary MOS is determined and subtracted; then NB, if relevant, is quantified and subtracted; and then the remainder is allocated among pollutant sources. When the breakdown and allocation is completed we have a TMDL, which must equal the LC.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. Also a required part of the loading analysis is that the LC be based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both LC and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear on the surface.

A load is fundamentally a quantity of a pollutant discharged over some period of time, and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for “other appropriate measures” to be used when necessary. These “other measures” must still be quantifiable, and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads, and allow “gross allotment” as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

5.1 Instream Water Quality Targets

Instream water quality targets are the basis for load calculations. From these targets, loads for the various water bodies are calculated. Although TMDLs are expressed in a mass per unit time, as required by the CWA and EPA, the instream targets are typically what the local stakeholders look to when they assess data collected on their streams of concern. As a result, instream water quality targets should be something understandable such as water quality standards or other straightforward targets. Complex targets can be just as confusing and as unworkable as load calculations and should be avoided.

Instream water quality targets for the Goose Creek Subbasin were chosen from a variety of sources. Principally, the Idaho Water Quality Standards were used to set instream targets. The water quality standards related beneficial use impairment to a narrative standard; however (e.g., IDAPA 58.01.02.200.03 "...surface waters shall be free from deleterious materials in concentrations that impair beneficial uses."), other sources were consulted to determine appropriate instream water quality targets. Other sources used to determine appropriate instream water quality targets were the Clean Water Act, the Code of Federal Regulations, EPA technical support documents and guidelines, other states' water quality standards, other TMDLs written by the state of Idaho and submitted to or approved by EPA, and scientific papers from refereed journals. Instream water quality targets developed from sources other than the state of Idaho's water quality standards will be reviewed at such time that numeric standards are adopted and codified by the state of Idaho following negotiated rule making. Targets were developed for four pollutants found to be impairing the beneficial uses of the listed water bodies identified in previous sections of the SBA. These pollutants are nutrients, bacteria, sediment, and temperature. Other pollutants have been demonstrated to be not degrading the beneficial uses in the various listed water bodies. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of specific pollutants as "pollution." TMDLs are not required for water bodies impaired by pollution, but not specific pollutants.

Design Conditions

Typically, design conditions are based upon the critical periods for specific beneficial uses respective of the pollutants and water bodies or upon some reference system within the subbasin or creek. Design conditions often vary from stream to stream for various pollutants. One of the reasons for such variability is the different land use practices along each stream. Other factors also increase loadings at different times of the year from pollutant to pollutant. For example, TP and sediment may impair a beneficial use on a stream at different times of the year. Typically, sediment is more likely to impact a system in the spring runoff during higher flow, while TP will impact a stream during summer growing seasons. Therefore, the critical periods for each stream and each pollutant will be discussed separately. In addition, much of the sediment design was based upon reference reaches within each creek. In some cases prototypical reference conditions for stream bank erosion were used. These conditions will be outlined in the following sections.

Goose Creek

Goose Creek is a relatively homogeneous stream from a morphological standpoint. However, politically it appears that Goose Creek is very complex. It runs from Idaho, into Nevada, then into Utah, and back into Idaho. In the process it changes EPA jurisdiction three times and has three different state agencies involved in water quality. Currently Goose Creek is only on the Idaho §303(d) list. The other states' 2002 lists can be found at http://www.waterquality.utah.gov/documents/2002303final08-30-02.pdf (Utah) and at http://ndep.nv.gov/bwqp/303list.pdf (Nevada). It is very likely that Goose Creek should be listed by the other states. However, due to the remoteness, relative to the other states population centers, and limited miles within the other states it may have "fallen through a crack" in respect to §303(d) assessment and listing. Due to the relative homogeneous morphology of the creek the design conditions applicable in Idaho can be extrapolated into the other states and the loads and load allocations can be made for the other two states as well. These, however, would be purely informational as it would be up to the other states and EPA to determine if the stream should be §303(d) listed in the first place and the different states would have to develop their own loadings.

In the case of Goose Creek temperature issues, cold water aquatic life and salmonid spawning are the designated beneficial uses affected by increased temperature. The salmonid population consists or consisted of stocked and naturalized populations of rainbow trout, as well as native populations of cutthroat trout. Currently it is unknown if cutthroat trout inhabit the lower reaches of Goose Creek. It is likely that naturalized rainbows exist within the water body. The spawning and incubation periods of these salmonids range from early spring to the middle of the summer. These times should be considered the critical period for the beneficial uses of the stream. Temperature exceedances, of both the cold water aquatic life use and salmonid spawning, typically occur throughout the summer months. This period also corresponds with the end of the spawning and incubation periods of the rainbow and cutthroat trout. Discharge during the critical months of June and July averages 1.19 m^3/s. This value will be used in the following temperature TMDLs for Goose Creek.

The land use practices along the reach may have long term effects on the ability of Goose Creek to meet state water quality standards. Agricultural practices have removed significant portions of the riparian vegetation (both grazing and farming practices), changing the current shade of the stream. These land use practices do not necessarily occur only during the critical period but have occurred throughout the year and over the past several decades. As a result, the land use practices may only allow short pasture grasses and rangeland communities rather than a taller willow dominated riparian community to exist along the stream corridor. The temperature target selection will need to reflect this historic change in the riparian community and how it is applied with the solar pathfinder data.

Sediment also impairs the beneficial uses of Goose Creek. The elevated suspended load that occurs during the high spring flows impairs the uses. These flows also redistribute the bedload stored within the system throughout the year. Much of this load is coming from bank erosion of Goose Creek Load allocations will be developed using bank erosion rates developed by the NRCS and refined for TMDL use by the Idaho Falls Regional Office staff. The loads to the creek are derived from high flow events eroding unstable banks throughout the system. These loads can be estimated from bank heights and the percent unstable bank length within a system. The loads would then be reflective of average peak flow from the annual average hydrograph calculated from USGS data. For Goose Creek, this equates to a discharge of approximately 8.58 m^3/s and a recurrence interval of once every three years. Bankfull events (or recurrence intervals of 1.5 years) average 4.04 m^3/s.

Trapper Creek

It has been determined that nutrients and sediment impair the listed portion of Trapper Creek. Typically, sediments are more likely to impair the beneficial uses at higher flows while nutrients are more likely to impair a system during lower flows. Lower summer base flows in Trapper Creek range from 0.284 to 0.623 m^3/s (June through September) with an average of 0.386 m^3/s. The load capacity of nutrients will be based upon this average summer time flow.

Sediment also impairs the beneficial uses of the lower portions of Trapper Creek. The elevated suspended load that occurs during the high spring flows impairs these uses. These flows also redistribute the bedload stored within the system throughout the year. Much of this load is coming from bank erosion of Trapper Creek and from gullies and other ephemeral channels. Load allocations will be developed using bank erosion rates developed by the NRCS and refined for TMDL use by the Idaho Falls Regional Office staff. The loads to the creek are derived from high flow events eroding unstable banks throughout the system. These loads can be estimated from bank heights and the percent unstable bank length within a system. The loads would then be reflective of the average peak flow from the annual hydrograph calculated from USGS data. For Trapper Creek, this equates to a discharge of approximately 1.24 m^3/s and a recurrence interval of once every 2.4 years. Bank full events (or recurrence intervals of 1.5 years) average 0.82 m^3/s.

Birch Creek

It has been determined that the Birch Creek is impaired by nutrients and bacteria. Typically, sediments are more likely to impair the beneficial uses at higher flows while nutrients are more likely to impair a system during lower flows. Lower summer flows in Birch Creek range from 0.358 to 0.103 m^3/s with an average of 0.177 m^3/s. The load capacity of nutrients will be based upon the average flow during June through September.

Bacteria also impair the creek. Bacteria seem to impact the creek throughout the summer months into the fall. The critical period for the recreational beneficial uses is within May to October. Recreation activities occurring within the watershed during this period include hiking, biking, fishing, and hunting. It is equally likely that water would be ingested at any time during this period, but the highest concentrations of bacteria typically occur later in the season. This may be because of a change in land use practices, when the cattle are returned to pastures along the creek in the late summer through fall. At earlier times in the season, the cattle are located on rangeland further away from the stream. Therefore, to be protective of the beneficial use the design conditions should fall within the critical period when the bacteria contamination is most likely to occur. In Birch Creek this appears to be during the months of August and September. The design flow for the TMDL will be the average discharge from the fall or 0.136 m^3/s.

Cold Creek

The data collected and presented by DEQ in this report indicate that temperature impairs the beneficial uses of Cold Creek. The salmonid population consists or consisted of stocked and naturalized populations of rainbow and brook trout, as well as native populations of cutthroat trout. Currently it is unknown if cutthroat trout inhabit the lower reaches of Cold Creek. It is likely that naturalized rainbows exist within the entire water body. The spawning and incubation periods of these salmonids range from early spring to the middle of the summer for the trout and the fall through the winter for the char. The typical period for cutthroat trout (April 1 to July 1) should be considered the critical period for the beneficial uses of the stream as these fish meet the desired management goals of the IDFG. Temperature exceedances, of both the cold water aquatic life use and salmonid spawning, typically occur throughout the summer months. This period also corresponds with the end of spawning and incubation period of the cutthroat trout. Therefore, the design conditions for Cold Creek will be based upon the average flow conditions during the spawning and incubation period of the cutthroat trout. The average discharge during this period is 0.19 m^3/s.

Beaverdam Creek

It has been determined that Beaverdam Creek is impaired by nutrients, temperature, bacteria, sediment, and DO. Typically, sediments are more likely to impair the beneficial uses at higher flows while nutrients are more likely to impair a system during lower flows. Lower summer base flows in Beaverdam Creek range from 0.007 to 0.005 m^3/s. Assigning a load capacity for such a small stream often becomes pointless when flows are less than 0.007 m^3/s (or 0.25 cfs). At this point the question must be if the beneficial uses are actually impaired by flow rather than another constituent. Therefore, design flows less than 0.007 m^3/s will not be used. The lowest flows for which water quality standards apply to intermittent streams, 0.142 m^3/s for recreational uses and 0.028 m^3/s for aquatic life uses (IDAPA 58.01.02.070.06), will be used to determine meaningful load capacities in such small perennial streams. Load capacity will be developed using background concentrations determined from sample data corresponding with detection limits of nitrate plus nitrite within the Beaverdam Creek Watershed, or 0.129 mg/L TP.

The data collected and presented by DEQ in this report indicates that temperature also impairs the beneficial uses of Beaverdam Creek. The salmonid population consists or consisted of stocked and naturalized populations of rainbow trout, as well as native populations of cutthroat trout. Currently it is unknown if cutthroat trout inhabit Beaverdam Creek. It is likely that naturalized rainbows exist within the water body. The spawning and incubation periods of these salmonids range from early spring to the middle of the summer. The typical period for cutthroat trout (April 1 to July 1) should be considered the critical period for the beneficial uses of the stream as these fish meet the desired management goals of the IDFG. Temperature exceedances, of both the cold water aquatic life use and salmonid spawning, typically occur throughout the summer months. This period also corresponds with the end of the spawning and incubation period of the cutthroat trout. Therefore, the design conditions for Beaverdam Creek will be based upon the average flow conditions during the spawning and incubation period of the cutthroat trout (April thought June). The average discharge during this period is 0.039 m^3/s.

Bacteria also impair the creek. Bacteria seem to impact the creek throughout the summer months into the fall. The critical period for the recreational beneficial uses is May to October. Recreation activities occurring within the watershed during this period include hiking, biking, fishing, and hunting. It is equally likely that water would be ingested at any time during this period, but the highest concentrations of bacteria typically occur later in the season. However, the exceedances may depend on when in the rotation the Beaverdam pastures are used. Therefore, to be protective of the beneficial use the design conditions should fall within the critical period when the bacteria contamination is most likely to occur. In Beaverdam Creek this could be anytime during the grazing season (again depending on rotation pattern). The design flow for the TMDL will be the lowest flow that is meaningful to the users and the beneficial uses, which is 0.142 m^3/s for recreational beneficial uses (IDAPA 58.01.02.070.07).

Sediment also impairs the beneficial uses of Beaverdam Creek. The beneficial uses are impaired by elevated suspended load that occurs during the high spring flows and high use times of the year. These flows also redistribute the bedload stored within the system throughout the year. Load allocations will be developed using sediment rating curves and targets implemented in other TMDLs such as the Bruneau Subbasin Assessment and TMDL (Lay 2001) and the Middle Snake River Watershed Management Plan (Buhidar 1997). The loads to the creek are derived from high flow events eroding unstable banks throughout the system and mechanical erosion of the banks during high use periods as is seen in the water chemistry data. The suspended load can be estimated from average TSS concentrations and critical period flow. Load capacity will be derived from target concentration of 50 mg/L TSS and average peak flow. Average peak flow (0.054 m^3/s) will be used as this is typically the period in which the mechanical redistribution of suspended load occurs. Furthermore, this would be protective of early season salmonid spawning and cold water aquatic life.

Low DO impairs the beneficial uses of Beaverdam Creek. The design conditions for low DO will be based upon the TMDLs developed for temperature and nutrients. For further explanation, see Low Dissolved Oxygen target selection in this document.

Little Cottonwood

Bacteria impair the beneficial uses of Little Cottonwood Creek. Bacteria seem to impact the creek throughout the summer months into the fall. The critical period for the recreational beneficial uses is May to October. Recreation activities occurring within the watershed during this period include hiking, biking, fishing, and hunting. It is equally likely that water would be ingested at any time during this period, but the highest concentrations of bacteria typically occur later in the season. However, the exceedances may depend on when in the rotation the pastures are used. Therefore, to be protective of the beneficial use the design conditions should fall within the critical period when the bacteria contamination is most likely to occur. In Little Cottonwood Creek this could be anytime during the grazing season (again depending on rotation pattern). The design flow for the TMDL will be the lowest flow that water quality standards apply, which is 0.142 m^3/s for recreational uses (IDAPA 58.01.02.070.07).

Left Hand Fork Beaverdam Creek

It has been determined that Left Hand Fork Beaverdam Creek is impaired by nutrients, bacteria, and sediment. Typically, sediments are more likely to impair the beneficial uses at higher flows while nutrients are more likely to impair a system during lower flows. Lower summer base flows in Left Hand Fork Beaverdam Creek range from 0.007 to 0.005 m^3/s. Assigning load capacity for such a small stream often becomes pointless when flows are less than 0.007 m^3/s (or 0.25 cfs). At this point the question must be if the beneficial uses are actually impaired by water quantity or flow alteration rather than another constituent. Therefore, design flows less than 0.007 m^3/s will not be used. The load capacity of nutrients will be based upon the lowest flow to which water quality standards apply to intermittent streams, which is 0.142 m^3/s for recreational uses and 0.028 m^3/s for aquatic life uses (IDAPA 58.01.02.070.07).

Bacteria impair the beneficial uses of Left Hand Fork Beaverdam Creek. Bacteria seem to impact the creek throughout the summer months into the fall. The critical period for the recreational beneficial uses is May to October. Recreation activities occurring in the watershed during this period include hiking, biking, fishing, and hunting. It is equally likely that water would be ingested at any time during this period, but the highest concentrations of bacteria typically occur later in the season. Although the exceedances may depend on when in the rotation the pastures are used. Therefore, to be protective of the beneficial use, the design conditions should fall within the critical period and when the bacteria contamination is most likely to occur. In Left Hand Fork Beaverdam Creek this could be anytime during the grazing season (again depending on rotation pattern). The design flow for the TMDL will be the lowest flow for which water quality standards apply, which is 0.142 m^3/s for recreational uses (IDAPA 58.01.02.070.07).

Sediment also impairs the beneficial uses of Left Hand Fork Beaverdam Creek. The elevated suspended load that occurs during the high spring flows impairs these uses. These flows also redistribute the bedload stored within the system throughout the year. Much of this load is coming from bank erosion of Left Hand Fork Beaverdam Creek and from gullies and other ephemeral channels. Load allocations will be developed using sediment rating curves and targets implemented in other TMDLs such as the Bruneau Subbasin Assessment and TMDL (Lay 2001) and the Middle Snake River Watershed Management Plan (Buhidar 1997). The loads to the creek are derived from high flow events eroding unstable banks throughout the system and mechanical erosion of the banks during high use periods as is seen in the water chemistry data. The suspended load can be estimated from average TSS concentrations and critical period flow. Load capacity will be derived from a target concentration of 50 mg/L TSS and summer peak flow. Summer peak flow (0.04 m^3/s) will be used, as this is typically the period in which the mechanical redistribution of suspended load occurs. Furthermore, this would be protective of late season salmonid spawning and cold water aquatic life.

Target Selection

Target selection will be based upon water quality standards if appropriate numeric standards exist. For those water quality parameters, which fall under narrative standards, target selection will be based upon current usage within the DEQ TMDL program and TFRO-DEQ. For example: EPA nutrient guidelines are commonly used as nutrient targets; sediment targets are based upon European inland fisheries investigations, other DEQ TMDLs, or bank erosion inventory work done in other DEQ regions. In some cases target selection is based upon the statistical relationship between one pollutant and another pollutant. This approach to target selection was used for low DO TMDLs. Load calculations for low DO does not lend themselves to mass-per-unit-time computations. The Statistical approach was first explored in the Bruneau Subbasin Assessment and TMDL (Lay 2001) following discussions with EPA Idaho Operations Staff. Consequently, the same or similar approach was used in the Goose Creek SBA TMDLs.

Nutrients

Four water bodies within the Goose Creek Subbasin do not meet the narrative standard for nutrients. Therefore, these segments will be considered for application of a TMDL for restoration and protection of designated beneficial uses. Water quality will be restored through the TMDL process and the subsequent implementation plans developed by the land management agencies. The TMDLs will establish a limit on the quantity of nutrients that may enter the segments from sources in the local watersheds. The nutrient limits will be set at levels such that the segments will not exceed the estimated load capacities supportive of a good to excellent fisheries and will allow the water quality to improve to restore degraded beneficial uses. The TP targets for Trapper Creek shall be a monthly average of 0.05 mg/L of TP with a daily maximum of 0.08 mg/L to allow for natural variability. The average monthly target is within the range identified by EPA as supporting beneficial uses of water flowing into lakes and reservoirs. This will restore the beneficial uses of Trapper Creek and be protective of the reservoir as well. Total phosphorus targets for Birch Creek shall be set at 0.100 mg/L of TP with a daily maximum of 0.160 mg/L of TP to allow for natural variability in those streams. The average monthly target is within the range identified by EPA as supporting beneficial uses of free flowing streams and rivers. The TP targets for Beaverdam Creek and Left Hand Fork Beaverdam Creek shall be set at a daily maximum of 0.129 mg/L TP each. This level has been determined to be the average natural background levels from data collections made from spring sources and from within the watershed when other constituents are below detection limits and anthropogenic factors are limited within the watershed.

Total phosphorus target values do not imply that degradation by TP may occur up to the target value. Rather, TP values should be less than the respective targets on an average monthly basis and daily maximum, which will allow for some exceedances of the instream standards to account for seasonal and daily variation. However, it is DEQ's administrative policy under IDAPA 58.01.02.050.01 that the adoption of water quality standards and the enforcement of such standards is not intended to conflict with the apportionment of water to the state through any of the interstate compacts or court decrees or to interfere with the rights of Idaho appropriators, either now of in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure. IDAPA 58.01.02.50.02.a states: "Wherever attainable, surface waters of the state shall be protected for beneficial uses which for surface waters includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota." The existing and designated beneficial uses of these segments will be protected through the TMDL process as legally described. Acts of God and or uncontrollable flood/drought events will be exempt during the period of impact until such time that the impact is stabilized and the "imminent and substantial danger to the public health or environment" (IDAPA 58.01.02.350.02.a) is minimized so that the activity may be conducted in compliance with approved BMPs…to fully protect the beneficial uses (IDAPA 58.01.02.350.02.b.ii. (2)). Other activities that may cause degradation, but which are outside the scope of IDAPA 58.01.02.050.01 and which there is foreknowledge of the event's occurrence, will require a formal written letter from the individual, organization, or agency to DEQ-TFRO about the nature of the potential event. If the activity violates IDAPA 58.01.02.350.02.b.i, such that it will occur in a manner not in accordance with approved BMPs, or in a manner that does not demonstrate a knowledgeable and reasonable effort to minimize the resulting adverse water quality impacts, then DEQ-TFRO will seek intervention by the Director of DEQ for preparation of a compliance schedule (as provided in Idaho Code 39-116). DEQ may also institute administrative or civil proceedings including injunctive relief as provided in Idaho Code 39-108.

Beneficial uses may be fully supported at higher rates of nutrient loading. The implementation strategy for the nutrient impaired streams is to establish a declining trend in nutrient load indicator targets (chlorophyll *a* and TP) and to regularly monitor water quality and beneficial uses support status. If it is established that fully supported uses are achieved at intermediate nutrient loads above natural background levels, and that the narrative nutrient standards are being met, the TMDL will be revised accordingly.

Temperature

Goose Creek, Cold Creek, and Beaverdam Creek exceed the temperature water quality standards for their designated beneficial uses of cold water aquatic life and salmonid spawning. State water quality temperature standards for cold water aquatic life are 22 °C or less with a daily average of no greater than 19 °C. Those standards established for salmonid spawning are water temperatures no greater than 13 °C and a maximum daily average no greater than 9 °C during the spawning and incubation period of the particular salmonid community within the water body.

In addition to the state water quality standards, a solar pathfinder based data will be used to determine instream temperatures based on reference location average shade. The numeric standards do not apply in all cases because they realistically cannot be met throughout the reach, even under ideal shading. In these cases, the "best achievable thermal load" is used as the target. The best achievable thermal load is based on the practical amount of shading possible as defined in the TMDL by shade and solar pathfinder data collected on reference streams within the region. This data was collected from ten transects space approximately 500 meters apart on each stream. The shade from each transect was used to determine the stream average shade and the over all average shade.

Site potential shading characteristics are derived from similar riparian communities within the Goose Creek, Raft River, and Upper Snake-Rock Subbasins. Site potential shading is not an estimate of presettlement conditions. These subbasins have seen changes because of anthropogenic impacts (e.g. channel armoring, straightening, entrenchment, and farming practices) and the historic condition is no longer attainable or attainable in the very long term. Thus, site potential shading is based upon maximum vegetation heights, maximum density, and optimal vegetative offset of the riparian community based upon a group of streams with fully supported beneficial uses, located within south central Idaho. These factors also influence the bank stability of a system. Potential changes in width/depth ratios are also taken into account for the particular channel type, but changes in the existing channel type are not modeled. The Goose Creek Subbasin temperature TMDLs will be based upon the site potential shading or thermal load from five streams with fully supported beneficial uses. These streams are examples of high quality waters that are available to develop the maximum thermal load target for south central Idaho. Extrapolation outside of this area should be undertaken with some reservations until reference shade can be determined for a greater area. The first of these five reference streams was the upper fully supporting segment of Trapper Creek. The percent shade, as determined from solar pathfinder data, indicates that Trapper creek averages 28 percent shade during June through August. The second site was the fully supporting segments of Stinson Creek, which is in the Raft River Subbasin. Stinson Creek is 34 percent shaded. Cross Creek was the third stream used, as it was another fully supporting stream within the Raft River Subbasin. It was determined that Cross Creek is also 28 percent shaded. Two Streams were selected in the Upper Snake-Rock subbasin, The upper portions of Rock Creek and North Cottonwood Creek were the fourth and fifth sites. Both have been assessed using WBAG II and within the Upper Snake Rock TMDL and have been determined to meet beneficial uses and have no temperature related impacts to the beneficial uses. It was determined that Rock Creek is 64 percent shaded while North Cottonwood Creek is 55 percent shaded. As other streams are located within the general area the maximum thermal load will become more robust as the values from those streams are incorporated into the average of the reference streams. The current reference stream average is 42 percent shade during the months June, July, and August.

The Goose Creek Subbasin has always had high summer temperatures, high solar radiation, and low summer flows. Temperatures are exacerbated by certain land use practices including flow diversion, but water temperatures have most likely never been cold during the hottest part of the year. Native fishes have either physiologically adapted to the high temperatures or have take thermal refuge in and near the spring sources located throughout the various creeks. Factoring in these natural conditions, these temperature targets are based upon the temperature decrease expected under optimal habitat conditions, which, while potentially above the state numeric criteria, are protective of the native fish community and their reproduction.

Bacteria

The state of Idaho has a water quality standard for *E. coli* that covers both primary and secondary contact recreation. All of the systems in the subbasin are undesignated water bodies except Goose Creek and Goose Creek Reservoir. The undesignated water bodies are afforded protection for primary and secondary contact recreation according to IDAPA

58.01.02.101.01.a. After a review of the physical properties of the listed systems, DEQ-TFRO has determined that likely recreational activities include fishing, wading, and infrequent swimming. These recreational activities are descriptive of the existing uses consistent with secondary contact recreation. As a result, the water quality bacteria targets will be those water quality criteria for secondary contact recreation. Thus, the number of colonies of *E. coli* shall not exceed a single instantaneous sample of 576 col/100 ml and the geometric mean of five samples collected in a 30 day period of 126 col/100 ml.

Additionally, the target bacteria load (576 col/100 ml) will be segregated into percentages based on land uses. Thus, if 40 percent of the land use is attributable to agriculture, then 230 col/100 ml of the target will be distributed to agriculture. The remainder (576 - 230 = 346 col/100 ml) will be distributed to the other land uses where appropriate. An essential assumption in this method of distribution is that the water quality standard is the load capacity of a system. By using a percentage of the target or "load capacity," the calculations become unitless percentages, which overcomes the inherent problem of calculating loads from a parameter that does not lend itself to loading calculations. Allocations can then be made from this percentage of the load according to land use in the watershed. The MOS (10 percent in all cases) would be used to hold back a percent of the load from the load capacity.

Compliance with the water quality target and the TMDL will be based on the geometric mean (126 col/100 ml) for secondary contact recreation as described in the IDAPA regulations. Because the major exceedances occur primarily during the grazing season (April through September), monitoring of the water bodies will occur primarily during the grazing season, although year-round monitoring may be developed so that comparisons between the grazed and nongrazed seasons can be assessed. It is recognized that bacteria are a singular parameter that has a statistically significant linkage to TSS. (see Upper Snake Rock TMDL [Buhidar 1999] for review of surrogate use of TSS for bacteria reductions.) During the implementation phase of this TMDL, land management agencies will provide guidance as to site-specific BMPs that will effectively reduce *E. coli*, such that conjunction with TSS reductions will yield *E. coli* reductions and eventually meet beneficial uses and/or state water quality standards.

Sediment

The antidegradation policy for the state of Idaho (IDAPA 58.01.02.051(01)) indicates that the existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected. Most of the listed segments (listed for sediments in the 1998 §303(d) list) in the Goose Creek Subbasin appear to be meeting the narrative standard for suspended sediment, although they are not meeting the assessment criteria (percent surface fines) for bedload sediments. Because of this, water quality degradation due to suspended sediment beyond these conditions shall not occur, but shall be maintained at or below these levels throughout the implementation of the TMDL.

The sediment limit, in the listed segments of the subbasin, will be set at a level such that the rivers and streams will not exceed the estimated load capacity supportive of a good fishery and will not allow the water quality to degrade worse than current levels. This target shall be a monthly average of less than 50 mg/L of TSS with a daily maximum of 83 mg/L to allow for natural variability. The average monthly target is within the range identified by the European Inland Fisheries Advisory Commission (EIFAC 1965) and the Committee on Water Quality Criteria from the Environmental Studies Board of the National Academy of Science and National Academy of Engineers (NAS/NAE 1973) as supporting a moderate fishery.

Total suspended sediment values of less than 50 mg/L do not imply that degradation by TSS may occur up to 50 mg/L. Rather, TSS values should be less than 50 mg/L on an average monthly basis, which will allow for some exceedances of the in-stream standard to account for seasonal and daily variation. However, it is DEQ's administrative policy under IDAPA 58.01.02.050.01 that the adoption of water quality standards and the enforcement of such standards is not intended to conflict with the apportionment of water to the state through any of the interstate compacts or court decrees, or to interfere with the rights of Idaho appropriators, either now of in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure. IDAPA 58.01.02.50.02.a states "Wherever attainable, surface waters of the state shall be protected for beneficial uses which for surface waters includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota." The existing and designated beneficial uses of the subbasin will be protected through the antidegradation as previously described. Acts of God and or uncontrollable flood/drought events will be exempt during the period of impact until such time that the impact is stabilized and the imminent and substantial danger to the public health or environment (IDAPA 58.01.02.350.02.a) is minimized so that the activity may be conducted in compliance with approved BMPs…to fully protect the beneficial uses (IDAPA 58.01.02.350.02.b.ii. (2)).

Other activities that may cause degradation, but which are outside the scope of IDAPA 58.01.02.050.01 and which there is foreknowledge of the event's occurrence will require a formal written letter from the individual, organization, or agency to DEQ-TFRO about the nature of the potential event. If the activity violates IDAPA 58.01.02.350.02.b.i, such that it will occur in a manner not in accordance with approved BMPs, or in a manner which does not demonstrate a knowledgeable and reasonable effort to minimize the resulting adverse water quality impacts, then DEQ-TFRO will seek intervention by the Director of DEQ for preparation of a compliance schedule (as provided in Idaho Code 39-116). DEQ may also institute administrative or civil proceedings including injunctive relief as provided in Idaho Code 39-108.

Loads for the bedload fraction of sediment will be developed to meet the beneficial uses of the streams and maintain the above TSS targets using a stream bank erosion estimate developed by the NRCS and refined for TMDLs by the Idaho Falls Regional Office. The current state of science does not allow specification of a sediment load or load capacity to meet the narrative criteria for sediment to fully support beneficial uses for cold water aquatic life and salmonid spawning. All that can be said is that the load capacity lies somewhere between current loading and levels that relate to natural stream bank erosion levels. It is assumed that beneficial uses were or would be fully supported at natural background sediment loading rates. These rates were assumed to equate to the 80 percent bank stability regimes required to meet state water quality standards.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in sediment load indicator targets (TSS and percent surface fines) and to regularly monitor water quality and beneficial uses support status. If it is established that fully supported uses are achieved at intermediate sediment loads above natural background levels, and that the narrative sediment standards are being met the TMDL will be revised accordingly.

Dissolved Oxygen

Beaverdam Creek exceeds the DO water quality standard for its designated beneficial use of cold water aquatic life. The state water quality standard for cold water aquatic life requires that DO be greater than 6 mg/L at all times. Daytime levels of DO less than this standard occur occasionally, indicating that nighttime DO levels will often decrease below state water quality standards regularly. However, DEQ has not collected diel water quality data concerning DO in Beaverdam Creek nor has it collected, BOD data to determine an appropriate target to use to reduce the organic enrichment of Beaverdam Creek. Therefore a surrogate for BOD and low DO was devised. In other TMDLs (Lay 2000), TP was used as a surrogate for organic enrichment and low DO. A similar approach was taken to determine an appropriate surrogate target for Beaverdam Creek. Our assumptions were that DO would vary in relationship to temperature, nutrients, and solids entering the stream. It is well known that as temperature increases DO decreases. Other relationships between nutrients, DO, and TSS are not as well known. In the Jacks Creek Watershed of the Bruneau Subbasin a strong correlation existed between TP and DO. The likely explanation would be that as nutrients increase so does plant material and; therefore, BOD would increase (the decaying plants would increase oxygen consumption). Biochemical oxygen demand would have been a direct measurement; however, DEQ did not collected BOD on either creek. Secondly it was assumed that as suspended solids (allochonthonus organic material) increase, so too would BOD and therefore DO would decrease. To test these assumptions simple linear regression was performed with DO as the dependant variable in each case. As expected DO and temperature had a significant relationship ($p = 0.034$). However, the amount of variation described by the model was low ($R^2 = 0.375$). This indicated that another variable was possibly effecting DO concentrations. Similar tests with TSS and TP showed no significant relationship singularly with DO ($P = 0.145$ and 0.130 respectively). To determine if the original hypothesis was correct (that DO would vary in concert with temperature, TSS, or TP), backwards, step-wise, multiple regression was used to build the best predictive model for DO. The model determined from the statistical test (DO = Constant + TP + Temperature) was highly significant ($P= 0.002$) and accounted for a great deal of the variation ($R^2 = 0.757$). Therefore, DEQ shall use, as the surrogate for the DO TMDL, temperature and TP concentrations in the equation:

$$DO = 12.137 + (-1.679 * TP) + (-0.206 * Temperature).$$

Based upon the above equation, predicted DO levels would be well above the state water quality standards if TP concentrations were at nutrient target levels (0.129 mg/L) and temperature was not more than 29 °C. Therefore, the DO targets are those same targets determined to restore the beneficial uses of Beaverdam Creek in the nutrient TMDL.

Monitoring Points

The following are the compliance points to be used to determine if the various load allocations and waste load allocations are being met following implementation of the TMDLs.

Goose Creek

Goose Creek will be monitored near the bottom by the USGS gauge for compliance with the temperature TMDL. At this location HOBO loggers will be placed annually to determine if temperature targets are being met. Different monitoring locations may be required for the bedload TMDL. The locations will be used to determine if bank stability is increasing throughout the reach. These values will be used to extrapolate bank stability conditions to the remainder of the creek. These locations are yet to be determined. Local input via the Goose Creek group will play a major factor in the location of these monitoring points.

Trapper Creek

Trapper Creek will be monitored at two locations for compliance with the TMDLs. The first of these will near the USGS gauge. This location will serve as the compliance point for the nutrient TMDL. This was near the DEQ monitoring location for the SBA. Different monitoring locations may be required for the bedload TMDL. The locations will be used to determine if bank stability is increasing throughout the reach. These values will be used to extrapolate bank stability conditions to the remainder of the creek. These locations are yet to be determined. Local input via the Goose Creek WAG group will play a major factor in the location of these monitoring points.

Birch Creek

Birch Creek will be monitored for *E. coli* bacteria and TP near the old USGS gauge for compliance with the nutrient and bacteria TMDLs.

Cold Creek

Cold creek will be monitored near Goose Creek Road for compliance with the temperature TMDL. At this location HOBO loggers will be placed annually to determine if temperature targets are being met.

Beaverdam Creek

Beaverdam Creek is complex hydrologically speaking (see hydrology section of SBA). In effect, Beaverdam Creek is two water bodies: the upper water body from the confluence of the forks down to where subsurface flow begins above the old Emery Ranch and the lower water body below the springs at the Emery Ranch. Therefore, two compliance points will be required. The lower, below Emery Ranch will be used to determine the water quality of the lower segment and the upper will be used to determine compliance with the various TMDLs. The upper location should be located nearer the bottom of the upper reach possibly near 42°

1' 0" N 114° 2' 48" W. This would be several miles below the current monitoring point. However, the location will be moved upstream as needed into the perennial reach should the original location prove to be in the area that the creek dries out each year.

Little Cottonwood Creek

Little Cottonwood Creek will be monitored at one location to determine the compliance with the bacteria TMDL. This location shall be in the perennial reach of water upstream from Cowboy Spring at 42° 12' 50" N 113° 59' 17" W.

Left Hand Fork Beaverdam Creek

Left Hand Fork Beaverdam Creek will be monitored above the road crossing near the mouth of Johnny's Canyon for compliance with the sediment, nutrient, and bacteria TMDLs. The area below the road crossing has been determined to meet the targets and is meeting the beneficial uses at this time.

5.2 Load Capacity

The CWA requires that a TMDL be developed from a load capacity. A load capacity is the greatest amount of load that a water body can carry without violating water quality standards. In those instances where there are numeric water quality standards, the load capacity of a water body for different pollutants can be very straightforward. Most of the pollutants in the Goose Creek TMDL; however, do not have numeric water quality standards; rather they have narrative standards (e.g., IDAPA 58.01.02.200.03 "...surface waters shall be free from deleterious materials in concentrations that impair beneficial uses"), as referenced in this document. As a result, the load capacities of the various segments and tributaries in the Goose Creek Subbasin (Table 26) were estimated from extrapolations from the flow records available from USGS or DEQ and a variety of sources relating concentrations of pollutant to effects on "beneficial uses" or aquatic communities. Other sources used for concentrations were the CWA, the Code of Federal Regulations, EPA recommendations and guidelines, other states' water quality standards, other TMDLs written by the state of Idaho and submitted to or approved by EPA, and scientific papers from refereed journals. Load capacities developed from sources other than the state of Idaho's water quality standards will be reviewed at such time that numeric standards are adopted and codified by the state of Idaho following negotiated rule making. Additionally, load capacities were developed from flow regimes identified as critical periods. In some cases, these critical periods were low flow conditions during a particular season. In other cases, the flow regime during the critical period was determined to be at or near zero for several very small intermittent streams. In these cases, the lowest flow that water quality standards apply, which is 0.142 m^3/s for recreational uses and 0.028 m^3/s for aquatic life uses (IDAPA 58.01.02.070.07), was used to determine load capacity.

The load capacity and loading analysis models for the various streams and pollutants were derived from a mass balance approach of monitoring data, upstream monitoring, downstream monitoring, source monitoring, and estimations of loads from that data. Links to the water quality targets and beneficial uses were drawn from other TMDLs completed by the state of Idaho, EPA guidelines and recommendations, and scientific literature sources.

Nutrients

The LC for nutrients was determined by calculation using the target of 0.1 mg/L TP for free flowing streams or natural background concentrations and critical period flow values (calculated from predicted annual hydrographs). For streams flowing into reservoirs the LC was determined using the 0.05 mg/L TP target and critical period flow values (calculated from predicted annual hydrographs).

The phosphorus LC is identified for an average summer flow scenario (june through september). While these values are helpful in giving a relative understanding of the reductions required, and will apply reasonably over most water years, it should be noted that the absolute level of reduction required will depend on flow and concentration values specific to a given water year. The target shown to result in attainment of water quality standards and support of designated uses in the reach is an instream concentration of less than or equal to 0.1 mg/L TP. Transport and deposition of phosphorus, and the resulting algal growth within the reach, is seasonal in nature. Therefore, application of the 0.1 mg/L, 0.05 mg/L, or 0.129 TP targets are also seasonal in nature, extending from the beginning of June through the end of September. The length of this period was also determined by when BMPs would be most effective.

Due to water column nutrients, particularly TP, being more abundant than plant uptake rates, responses by plant communities to management efforts will take time. As TP inputs are reduced, plants that obtain nutrients from the water column (such as algae, epiphytes, and *Cerratophyllum sp.*) will likely be the first to decline. Because nutrients persist longer in sediments, plants that obtain nutrients from the sediments will persist longer. Nevertheless, as reductions in TP (and sediment) continue, sediment bound nutrients will gradually be depleted as plant uptake outpaces recharge rates.

Temperature

The primary source of temperature increases under anthropogenic control are those that increase the amount of solar radiation reaching the stream surface. Thus, the load of this resultant excess "heat" is calculated in kilowatts per hour per square meter per day (kwh/m^2/day). The LC is the amount of heat in the stream when the criteria or the best achievable temperature are met.

Based upon solar table and the reference streams' average shade conditions, the annual average thermal load capacity for streams in the Goose Creek Subbasin is estimated to be 2.1 kwh/m^2/day. During the critical period of June, July, and August the average load capacity is 4.1 kwh/m^2/day.

Bacteria

The LC for bacteria is based on the state water quality standard for *E. coli*. The bacteria LC is expressed in terms of percent of colony forming units. However, this is simply an accounting mechanism to convert a unit of measurement (colony forming units per 100 ml) to a unitless measurement because of the impracticality of converting to a mass per unit time measurement.

Sediment

The LC for sediment was determined based on the origin of the sediment. In those instances where the sediment generated from stream bank erosion, the LC is based on the load generated from banks that are greater than 70% stable. This load defines the LC for the remaining segments of the stream. In instances where a numeric water column target is defined, the LC is based on the instream load that would be present when the target is met. For example, the instream TSS target for Beaverdam Creek and Left Hand Fork of Beaverdam Creek is 50 mg/L. The LC for these creeks is based on maintaining 50 mg/L TSS throughout the streams during the critical flow period.

Dissolved Oxygen

The LC for DO will be based upon those developed for TP (see Table 29 for TP load capacity for Beaverdam Creek).

Table 29. Load capacities and critical periods.

Stream Name	Parameter	Critical Period	Load capacity[a]
Goose Creek	Temperature	June through July	4.1 kwh/m^2/day
Goose Creek	Sediment	March through May	1,294,371 kg/year
Trapper Creek	Nutrients	June through September	1.67 kg/day
Trapper Creek	Sediment	March through May	108,590 kg/year
Birch Creek	Nutrients	June through September	1.53 kg/day
Birch Creek	Bacteria	June through August	576 col/100 ml
Cold Creek	Temperature	June through July	4.1 kwh/m^2/day
Beaverdam Creek	Nutrients	June through September	0.32 kg/year
Beaverdam Creek	Temperature	June through July	4.1 kwh/m^2/day
Beaverdam Creek	Bacteria	June through August	576 col/100 ml

Stream Name	Parameter	Critical Period	Load capacity[a]
Beaverdam Creek	Sediment	March through May	232.26 kg/day
Beaverdam Creek	Dissolved oxygen	June through August	0.32 kg/year TP
Little Cottonwood Creek	Bacteria	June through August	576 col/100 ml
Left Hand Fork Beaverdam Creek	Nutrients	June through September	0.33 kg/day
Left Hand Fork Beaverdam Creek	Bacteria	June through August	576 col/100 ml
Left Hand Fork Beaverdam Creek	Sediment	March through May	31.78 kg/day

[a] kwh/m^2/day = kilowatt hours per square meter per day, kg/year = kilograms per year, col/100ml = colonies of *E. coli* per 100 ml of water.

5.3 Estimates of Existing Pollutant Loads

Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading," (40 CFR §130.2(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed), but may be aggregated by type of source or land area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads. In the Goose Creek Subbasin, data available to distinguish between nonpoint sources and background are very limited. In most cases, the anthropogenic stresses are applicable from the headwaters of a stream to its mouth. In these cases, it is assumed that the background levels of the various parameters are similar to other streams in south central Idaho. As such, background will be estimated for some streams until a better estimation or scientific evaluation can be made for each streams background load.

There are no point sources located within the Goose Creek Subbasin which discharge to any receiving water body regulated under the NPDES permit process. However, there are several CAFOs in the northern segment of the subbasin, below Lower Goose Creek Reservoir, that have NPDES permits. These facilities are allowed zero discharge and therefore would have a 0 kg per day WLA. It is uncertain at this time if there are any land application sites in the subbasin as well. These permitted facilities would also be allowed 0 kg per day discharge to the surface waters under their governing permits. Consequently, CAFOs and land application sites will not be addressed in the wasteload allocations.

Nutrients

In those streams determined to need nutrient TMDLs, natural background was assumed to be similar to that of the major drainages nearby. These drainages contain significant natural phosphorus deposits as well as some anthropogenic stresses. The background concentration of TP has been determined to be very low (0.02 mg/L). Nutrient background determinations will be discussed in greater depth in following sections. The nonpoint source load was assumed to be the difference between the existing load and natural background. The existing load was calculated from the critical flow and the average annual concentration of TP in the different streams. In Trapper Creek this was 0.108 mg/L, in Birch Creek this was 0.117 mg/L, in Beaverdam Creek this was 0.366 mg/L while in Left Hand Fork of Beaver Dam this was 0.221 mg/L.

The Beaverdam Creek Watershed required a different approach to determine natural background. Through discussion with local geological experts and observations during monitoring it was determined that the watershed contained natural deposits of phosphorus. The location of this source is unknown at this time. To determine background concentrations, samples were collected from the various spring sources within the Beaverdam Creek Watershed. These samples were inconclusive due in part to the heavy use of the springs in recent drought years. It was difficult to obtain samples that were not contaminated by sediment and other material. To test for contamination *E. coli* tests were run on the different springs concurrent with the TP collections. Although below state water quality standards, the tests indicated that the water collected from the springs was compromised. Therefore, DEQ returned to the original data set. During seasons of non or limited use, other measured constituents were often below detection limits. Therefore, DEQ assumed that during these times TP was also at or near background levels. The background concentration in the Beaverdam Creek Watershed was determined to be 0.129 mg/L when nitrite and nitrate were below detection limits. A similar analysis was completed in the other watersheds within the Goose Creek Subbasin and background levels ranged from 0.013 to 0.049 mg/L, which supports the natural background assumptions made about the nearby major drainanges.

Temperature

Existing temperature loads were estimated from the solar pathfinder model run with current vegetation cover, or percent solar time exposed (Table 30), to determine current kilowatt hours per square meter per day (Table 31). Natural background was considered the system potential load derived from the solar pathfinder model run with system potential cover.

Table 30. Stream potential and existing percent exposed solar time.

Month	Percent Potential Exposed Solar Time	Goose Creek Percent Exposed	Cold Creek Percent Exposed	Beaverdam Creek Percent Exposed
January	15	93	26	30
February	29	94	41	47
March	46	96	57	65
April	61	96	68	72
May	58	96	67	78
June	61	97	67	80
July	59	96	68	78
August	54	96	66	72
September	45	96	62	69
October	33	96	53	54
November	18	95	34	36
December	15	93	19	31

Bacteria

Little Cottonwood Creek provides the clearest methods for estimating bacteria loads. Natural background was estimated from average bacteria counts collected during the noncritical period (months April through May and October through November). The nonpoint source load was estimated from the difference in the previous number and average bacteria counts collected during the critical period (months June through September). The other three creeks' sampling regimes were very similar. Therefore, a similar approach was used to determine natural background levels and existing loads (Table 32). It should be noted that in other streams in south central Idaho (and the Goose Creek Subbasin) natural background counts of bacteria are near zero. Therefore, the additional background counts used in these TMDLs should be considered part of the implicit MOS.

Table 31. Potential and existing monthly solar load.

Month	Potential Solar Load[a]	Goose Creek Solar Load	Cold Creek Solar Load	Beaverdam Creek Solar Load
January	0.3	1.5	0.4	0.5
February	0.7	2.4	1.0	1.2
March	1.7	3.5	2.1	2.4
April	3.2	5.0	3.5	3.8
May	3.7	6.1	4.2	5.0
June	4.3	6.9	4.8	5.7
July	4.4	7.2	5.1	5.8
August	3.5	6.2	4.3	4.7
September	2.3	4.9	3.2	3.5
October	1.1	3.3	1.8	1.9
November	0.3	1.8	0.7	0.7
December	0.2	1.3	0.3	0.4

a Units in this table are kwh/m^2/day

Sediment

In Goose Creek the primary source of sediment is bank erosion. Existing sediment loads were determined using the bank erosion inventory process. This method provides an estimation of erosion rates within the sampling reaches. The erosion rate was then used to calculate the current instream delivery of sediment within the system. In other TMDLs, the background load was assumed to be similar to that from streams or reaches with slight to moderate bank erosion rates and 80 percent stable banks. Background loads developed for the suspended fraction of the sediment load were derived in a similar fashion as the bacteria and TP loads. Existing loads were determined from the average concentration of TSS during the anthropogenically elevated period (July through September) and average peak discharge. For Beaverdam Creek this was 560 mg/L TSS and for Left Hand Fork of Beaver Dam creek this was 78 mg/L

Dissolved Oxygen

Dissolved oxygen loads were developed from the required nutrient loads.

Table 32. Background and existing nonpoint source loads in the Goose Creek Subbasin.

Stream name	Pollutant	Natural Background[a]	Existing Load[a]	Existing wasteload[a]
Goose Creek	Temperature	4.1 kwh/m^2/day	6.7 kwh/m^2/day	0 kwh/m^2/day
Goose Creek	Sediment	1,294,371 kg/year	9,681,656 kg/year	0 kg/year
Trapper Creek	Nutrients	0.67 kg/day	3.60 kg/day	0.00 kg/day
Trapper Creek	Sediment	108,590 kg/year	1,526,157kg/year	0 kg/year
Birch Creek	Nutrients	0.31 kg/day	1.78 kg/day	0.00 kg/day
Birch Creek	Bacteria	98 col 100/ml	4872 col/100 ml	0 col/100 ml
Cold Creek	Temperature	4.1 kwh/m^2/day	4.7 kwh/m^2/day	0 kwh/m^2/day
Beaverdam Creek	Nutrients	0.117 kg/day	0.73 kg/day	0.00 kg/day
Beaverdam Creek	Temperature	4.1 kwh/m^2/day	5.4 kwh/m^2/day	0 kwh/m^2/day
Beaverdam Creek	Bacteria	351 col/100 ml	22,071 col	0 col/100 ml
Beaverdam Creek	Sediment	19 kg/day	2,601 kg/day	0 kg/day
Beaverdam Creek	Dissolved Oxygen	0.08 kg/day	0.83 kg/day	0.00 kg/day
Little Cottonwood Creek	Bacteria	7 col/100 ml	758 col/100 ml	0 col/100 ml
Left Hand Fork Beaverdam Creek	Nutrients	0.06 kg/day	0.58 kg/day	0.00 kg/day
Left Hand Fork Beaverdam Creek	Bacteria	55 col/100 ml	7,170 col/100 ml	0 col/100 ml
Left Hand Fork Beaverdam Creek	Sediment	2.54 kg/day	49.58 kg/day	0 kg/day

[a] kwh/m^2/day = kilowatt hours per square meter per day, kg/year = kilograms per year, col/100ml = colonies of *E. coli* per 100 ml of water.

5.4 Load Allocation

The total allocations must include a MOS to take into account seasonal variability and uncertainty. Uncertainty arises in selection of water quality targets, load capacity, and estimates of existing loads, and may be attributed to incomplete knowledge or understanding of the system, such as assimilation not well known, sketchy data, or variability in data. The MOS is effectively a reduction in loading capacity that "comes off the top" (i.e., before any allocation to sources). Second in line is the background load, a further reduction in loading capacity available for allocation. It is also prudent to allow for growth by reserving a portion of the remaining available load for future sources.

The load capacity is apportioned among existing and future pollutant sources. Allocations may take into account equitable cost, cost effectiveness, and credit for prior efforts, but all within the ceiling of remaining available load. These allocations may take the form of percent reductions rather than actual loads. Each point source must receive a waste load allocation (In the Goose Creek Subbasin this is zero see Table 32). Nonpoint sources may be allocated by subwatershed, land use, responsibility for actions, or a combination. It is not necessary to allocate a reduction in load for all nonpoint sources so long as water quality targets can be met with the reductions that are specified. In the Goose Creek Subbasin all load allocations are made using watershed area, if finer resolution is needed the load allocations can be made on land use within each watershed.

Margin of Safety

In addition to estimating a load capacity a given water body can carry, the Clean Water Act includes statutory requirements for a MOS in a TMDL. The MOS is intended to account for uncertainties in available data or in the actual effect controls will have on load reductions and the receiving water body's water quality. The MOS may be implicit, such as conservative assumptions used in various calculations, specifically those of natural background, loading capacity, wasteload allocations, and load allocations. Otherwise, a MOS must be clearly defined. For the Goose Creek Subbasin TMDLs, an explicit MOS will be set at 10 percent for all pollutant water body combinations. In addition, any conservative approaches used in the various calculations required by a TMDL will be included as an implicit component of the MOS. The implicit MOS; however, will not be clarified further. Rather, it will be assumed that conservative approaches taken throughout the document will have been sufficiently identified in appropriate sections.

Seasonal Variation

A TMDL must be established with consideration of seasonal variation. In the Goose Creek Subbasin there are seasonal influences on nearly every pollutant addressed. The summer growing season is when concentrations of bacteria and nutrients are the highest. This is also when water temperatures are elevated. The increase in temperature is due to a combination of agricultural diversion/return flow, warmer air temperatures, and a lack of stream shading. Seasonal variation as it relates to development of these TMDLs is addressed simply by ensuring that loads are reduced during the critical period (when beneficial uses are impaired and loads are controllable). Thus, the effects of seasonal variation are built into the load allocations.

Critical Period

The critical period for each water body is based on the time when beneficial uses must be protected and when pollutant loads or the stress on the beneficial uses are the highest. Each TMDL was developed such that the water quality standards will be achieved year around, yet the critical period defines when loading reductions must occur (see Table 29 for the critical period for each water body).

Background

Several recent Idaho TMDLs have discussed background levels for the various constituents. Much of that information is applicable to the Goose Creek Subbasin as well. Therefore the information was used in whole or in part *from The Big Wood River Watershed Management Plan* (Buhidar 2001)TMDL, the *Mid Snake Succor Creek TMDL* (Horsburgh 2003*), Snake River Hells Canyon TMDL* (Idaho DEQ and Oregon DEQ 2003) or *the Pahsimeroir River Subbasin Assessment and Total Maximum Daily Load* (Shumar and Reaney 2001) for the Goose Creek Subbasin TMDLs.

Nutrients

The following discussion comes from the *Snake River Hells Canyon TMDL* (SR-HC TMDL) (Oregon DEQ and Idaho DEQ 2003). The SR-HC TMDL assessed natural phosphorus conditions in the mainstem Snake River by looking at concentrations in the Blackfoot and Portneuf watersheds where there are high naturally occurring concentrations of phosphorus. Natural sources of nutrients include erosion of phosphorus-containing rock and soils through wind, precipitation, temperature extremes, and other weathering events.

“Natural deposits of phosphorus (Hovland and Moore 1987) have been identified in the Snake River drainage near Pocatello, Idaho (RM 731.2). Geological deposits in the Blackfoot River watershed (inflow at river mile [RM] 750.6) contain phosphorus in sufficient concentrations that they have been mined. The Snake River flows through this area some distance upstream of the SR-HC TMDL reach.

In an effort to assess the potential magnitude of natural phosphorus concentrations in the mainstem Snake River due to these geological deposits, total phosphorus concentrations occurring in the mainstem near the Blackfoot and Portneuf River inflows (RMs 750.6 and 731.2, respectively) were evaluated. Data were available for the Snake River near Blackfoot, Idaho (USGS gauge No. 13069500, RM 750.1) and for the Blackfoot and Portneuf Rivers (USGS 2001a). The mainstem Snake River and these tributary river systems, where they flow through the natural mineral deposits, represent a worst-case scenario for evaluation of natural phosphorus loading and were identified as potential sources of naturally-occurring phosphorus to the SR-HC reach. The USGS gauged flow data and water quality data from the 1970s to the late 1990s is available for the Blackfoot and Portneuf Rivers (USGS gauge No. 13068500 and No. 13075500, respectively). Because both the mainstem and tributary watersheds have been settled for some time, and land and water management has occurred extensively, the data compiled represent both natural and anthropogenic loading.

Total phosphorus concentrations in the Snake River mainstem, measured near Blackfoot, Idaho (RM 750.1), from 1990 to 1998 averaged 0.035 mg/L (range ≤ 0.01 to 0.11 mg/L, median = 0.03 mg/L, mode = 0.02 mg/L) (USGS 2001a). Nearly 40 percent (23 samples) of the total data set showed total phosphorus concentrations less than or equal to 0.02 mg/L. The data represent year-round sampling. Winter sampling was slightly less frequent (approximately 19% of the total) than spring, summer, or fall sampling.

Natural phosphorus concentrations were not assessed as part of the Blackfoot River TMDL (DEQ 2001b). Total phosphorus concentrations in the Blackfoot River, measured near the mouth, from 1990 to 1999 averaged 0.069 mg/L (range ≤ 0.01 to 0.43 mg/L, median = 0.04 mg/L, mode = 0.03 mg/L) (USGS 2001a). Nearly 23 percent (12 samples) of the total data set showed total phosphorus concentrations less than or equal to 0.02 mg/L. The data represent year-round sampling. Winter sampling was less frequent (approximately 13% of the total) than spring, summer, or fall sampling.

Natural phosphorus concentrations were not assessed for the Portneuf River TMDL (DEQ, 1999d). Total phosphorus concentrations in the Portneuf River, measured near the mouth, from 1990 to 1998 averaged 0.085 mg/L (range = <0.01 to 0.28 mg/L, median = 0.069 mg/L, mode = 0.03 mg/L) (USGS, 2001a). Nearly 21 percent (6 samples) of the total data set showed total phosphorus concentrations less than or equal to 0.02 mg/L. Data represents year-round sampling. Winter sampling represented approximately 22 percent of the total.

The fact that very low total phosphorus concentrations were observed routinely (more than 20% of the time) in the mainstem Snake River, the Blackfoot River and the Portneuf River, all watersheds with a high level of use and management show that the natural loading levels are likely below detection limit concentrations. The additional fact that these low concentrations were observed in watersheds in much closer proximity to the rich geological phosphorus deposits than the Goose Creek Subbasin indicates that these deposits likely do not represent a significant source of high, natural loading to the Goose Creek TMDL reaches.

Given the above discussion, the natural background concentration for TP in the mainstem Snake River has been estimated as at or below 0.02 mg/L for both the Mid Snake River/Succor Creek and SR-HC TMDL reaches. This value is based on the available data set. Data from the Snake River upstream of RM 409 were included in this data set to address the concern of enrichment of surface waters by the phosphoric deposits located in central and eastern Idaho (Hovland and Moore 1987). Due to the fact that there are substantial anthropogenic influences in Snake River Basin, the lower 15th percentile value for total phosphorus concentration was selected as a conservative estimate of the natural phosphorus concentration. In this manner, natural concentration levels for the mainstem Snake River were calculated conservatively. This initial estimate will be reviewed as additional data become available and revisions will be made as appropriate.

The estimated natural background loading concentration for the mainstem Snake River (0.02 mg/L) is most likely an overestimation of the natural loading but represents a conservative estimate for the purposes of load calculation. In addition, this concentration correlates well with other studies that have been completed and closely approximates the TP concentration identified for a reference system (relatively unimpacted) by the US EPA (US EPA 2000d, Dunne and Leopold 1978). Because phosphorus concentrations had dropped to below the detection limit in the Blackfoot watershed after implementation of BMPs, background was assessed at 0.02 mg/L based on the lowest 15th percentile value for phosphorus. This choice of percentile addressed bias introduced by using a lower percentile that contained values below the detection limit and lack of data located directly below the natural source of phosphorus."

Based upon this information, natural background will be assumed to be 0.02 mg/L in the Goose Creek Subbasin unless otherwise noted as in the Beaverdam Creek Watershed.

Temperature

Background for temperature is considered to be the amount of heat in the water when the maximum riparian potential is met. Thus, the background temperature is the same as the loading capacity.

Bacteria

Background bacteria colonies enter the stream from many sources not controllable through the TMDL process. Generally, these sources are from the wildlife that use the stream. In some cases, waterfowl have been shown to be a significant contributor of *E. coli* (Campbell 2001). Other studies have indicated that skunks, ground squirrels, and other small mammals may be significant contributors. No work has been done in the Goose Creek Subbasin to partition these sources from the overall counts. This would entail genetic differentiation of the *E. coli* found within each watershed. Rather than a detailed genetic study of the *E. coli*, DEQ opted to make some simple assumptions about the sources. The first of these is that the contributions from wildlife sources of *E. coli* are similar throughout the year. The second is that anthropogenic sources are more heavily concentrated during the summer. These sources may include recreation as well as grazing. If these two assumptions are met then the uncontrollable portion, that from the wildlife sources, could be identified as the average counts for the period when anthropogenic sources are minimized. This count would vary from watershed to watershed depending on the utilization of the watershed by the local wildlife population.

Sediment

Background sediment production from stream banks equates to the load at 80 percent stream bank stability as described in Overton et al. (1995), where stable banks are expressed as a percentage of the total estimated bank length. The natural condition stream bank stability potential is generally at 80 percent or greater for A, B, and C channel types in plutonic, volcanic, metamorphic, and sedimentary geology types.

Suspended sediment production is assumed to follow a similar pattern as bacterial contamination, although this production should also include the spring runoff period as well. In order to determine the natural background concentration of TSS for the Goose Creek Subbasin the average concentration for the month of October subbasin wide was determined. This early fall sampling data would fall within the time frame when most anthropogenic stresses were minimized throughout the subbasin. Additionally the flow regime would be minimized so that redistribution of sediment via hydrological parameters would also be minimized. As a result the results should give yield a subbasin wide average background concentration of TSS. The value will be reassessed once a more complete data set exist. Currently Background TSS for load calculations will be 4 mg/L or the average concentration collected to date in the month of October.

Dissolved Oxygen

The DO TMDL was developed from an empirically derived equation relating DO levels to temperature and nutrient concentrations. The other aspects of the TMDL, such as background, are the same as those derived for TP and temperature. Therefore, the background load for DO is the same as the TP TMDL or 0.08 kg/day TP.

Reserve

An allowance in the TMDL for a portion of the loading capacity to be set aside for future growth is permissible and encouraged. Careful documentation of the decision making process must accompany the TMDL. This allowance for future growth must be based on existing or readily available data at the time of the TMDL development if it is to be applicable to the assumptions and calculations used to develop the TMDL loads. In the Goose Creek Subbasin, little discussion with the local stakeholders has occurred in regards to a reserve load. In fact, the Lake Walcott WAG has historically chosen to forgo the use of a reserve. Further discussions with the Goose Creek stakeholders are required. If it is deemed feasible a reserve may be developed in a similar fashion as the Wood River WAG used; the reserve will be developed during the implementation of the TMDL. Nevertheless, it should be noted that developing a reserve post hoc will result in more stringent load reductions than presented in the various TMDLs.

Remaining Available Load

The following should be considered the tabular summarization of the SBA and TMDL processes (Table 33). The information also the meets the legal definition of a TMDL such that:

$$TMDL = LC = NB + MOS + LA + WLA$$

Additionally, there are no point sources within the watersheds. Therefore, no wasteload allocations were made. Nonpoint sources were allocated by subwatershed. It is incumbent upon the land management agencies and private individuals to develop the appropriate BMPs to meet the nonpoint source load allocations during the implementation plan development. A finer allocation based upon land ownership, land use, or other mechanism is not needed so long as water quality targets can be met by the aggregate reductions of those sources that are prescribed a reduction in load through the implementation plan. Reach level allocations based upon the stream bank erosion process are presented in Table 34 for Trapper Creek and Table 35 for Goose Creek.

Table 33. Goose Creek Subbasin TMDLs.

Creek	Pollutants[a]	Target[b]	critical period	Critical flow (m^3/s)[c]	load capacity	Back Ground	Total load	MOS[d]	LA[e]	Load Reduction	Percent reduction	Units[f]
Goose Creek	Temp	4.1	June through July	1.19	4.1	4.1	6.7	0.4	3.7	3.0	44.78	Kwh/m^2/ day
Goose Creek	Sed.	70% B.S.	March through May	8.58	1,294	1,294	10,976	Imp.	1,294	9,682	88.21	Mg/year
Trapper Creek	Nut.	0.050 mg/L	June through Sept	0.386	1.67	0.67	3.60	0.17	0.83	2.77	76.94	kg/day
Trapper Creek	Sed.	70% B.S.	March through May	1.24	152	152	3,567	Imp.	152	3,415	95.73	Mg/year
Birch Creek	Nut.	0.100 mg/L	June through Sept	0.177	1.53	0.31	1.78	0.15	1.02	0.76	42.69	kg/day
Birch Creek	Bact.	576	June through August	0.142	576	98 col	4872	58	420	4,452	91.38	col/100 ml
Cold Creek	Temp	4.1	June through July	0.19	4.1	4.1	4.7	0.4	3.7	1.0	21.28	Kwh/m^2/ day
Beaverdam Creek	Nut.	0.129 mg/L	June through Sept	0.01	0.315	0.117	0.331	0.03	0.168	0.163	49.82	kg/day
Beaverdam Creek	Temp	4.1	June through July	0.04	4.1	4.1	5.4	0.4	3.7	1.7	31.48	Kwh/m^2/ day
Beaverdam Creek	Bact.	576	June through August	0.142	576	351	22,071	58	167	21,904	99.24	col/100 ml
Beaverdam Creek	Sed.	50 mg/L	March through May	0.054	232.3	19	2,601	23	190.3	2,410	92.68	kg/day
Beaverdam Creek	DO	0.129 mg/L	June through August	0.01	0.315	0.117	0.331	0.03	0.168	0.163	49.82	kg/day

Creek	Pollutants[a]	Target[b]	critical period	Critical flow (m^3/s)[c]	load capacity	Back Ground	Total load	MOS[d]	LA[e]	Load Reduction	Percent reduction	Units[f]
Little Cottonwood Creek	Bact.	576	June through August	0.142	576	7	758	58	511	247	32.59	col/100 ml
Left Hand Fork Beaverdam Creek	Nut.	0.129 mg/L	June through Sept	0.007	0.33	0.06	0.58	0.03	0.24	0.34	58.66	kg/day
Left Hand Fork Beaverdam Creek	Bact.	576	June through August	0.142	576	55	7,170	58	463	6,707	93.54	col/100 ml
Left Hand Fork Beaverdam Creek	Sed.	50 mg/L	March through May	0.007	31.	2.54	49.58	3	25.46	24.12	48.65	kg/day
Temp. = Temperature, Sed. = Sediment, Nut. = nutrients (TP), Bact. = Bacteria, B.S. = Bank Stability, DO = Dissolved Oxygen, and Imp. = Implicit.												

[a] Temp. = temperature, Sed. = sediment, Nut.= nutrients, Bact. = bacteria, DO = low dissolved oxygen.
[b] B.S. = Bank Stability, mg/L = milligrams per liter.
[c] m^3/s = cubic meters per second
[d] Imp. = Implicit margin of safety
[e] LA = Load Allocation
[f] $kwh/m^2/day$ = kilowatt hours per square meter per day, Mg/year = Megagram per year, kg/day = kilogram per day, col/100ml = colonies per 100 milliliters of water

Table 34. Trapper Creek bank erosion load reductions.

Reach	Existing		Proposed			
	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate Percent Reduction	Percent of Existing Total Load
Headwaters	11.79	6.35	9.98	5.17	15.38	0.18
Middle Reach	44.45	230.42	11.79	61.42	73.47	6.46
Pasture Reach	227.70	445.43	12.70	25.31	94.42	12.49
Lower Reach	1,060.50	952.54	19.05	16.69	98.20	26.70
Gullies	1,653.80	1,932.30	37.19	43.91	97.75	54.17
Total Erosion (Mg/y)		3,567.05		152.50	95.72	100.00

[a] Megagram per mile per year
[b] Megagram per year

Table 35. Goose Creek bank erosion load reductions.

Reach	Existing		Proposed			
	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper Idaho	0.9	15.4	7.3	103.1	0	0.14
Nevada Reference	15.4	164.2	15.4	164.2	0	1.50
Nevada from wine cup to Utah	198.7	4,583.1	17.2	402.4	91	41.76
Utah to Idaho	291.2	2,263.4	21.8	165.6	93	20.62
Idaho border to Coal Banks	432.7	3,178.8	27.2	199.3	94	28.96
Coal Banks to Cave Gulch	88.9	764.8	25.4	221.5	71	6.97
Cave Gulch to Reservoir	2.7	6.4	16.3	38.2	0	0.06
Total Erosion (Mg/y)		10,976.0		1,294.4	88.21	100.00

[a] Megagram per mile per year
[b] Megagram per year

5.5 Implementation Strategies

The purpose of this implementation strategy is to outline the pathway by which a larger, more comprehensive, implementation plan will be developed 18 months after TMDL approval. The comprehensive implementation plan will provide details of the actions needed to achieve load reductions (set forth in a TMDL), provide a schedule of those actions, and specify monitoring needed to document actions and progress toward meeting state water quality standards. These details are typically set forth in the plan that follows approval of the TMDL. In the meantime, a cursory implementation strategy is developed to identify the general issues such as responsible parties, a time line, and a monitoring strategy for determining progress toward meeting the TMDL goals outlined in this document.

Overview

The objective of the Goose Creek Subbasin TMDLs is to allocate allowable loads among different pollutant sources so that the appropriate control actions can be taken and water quality standards achieved. The total pollutant loads on these water bodies are derived from nonpoint and background sources. The Goose Creek Subbasin TMDLs have attempted to consider the effect of all activities or processes that cause or contribute to the water quality limited conditions of not just the water bodies listed on the 1998 §303(d) list, but rather all potential sources. Control measures to implement this TMDL do not contain NPDES authorities, but are based on the reasonable assurance that state, federal, and local authorities will ensure that actions to reduce nonpoint source pollution will occur. "There must be assurances that nonpoint source control measures will achieve expected load reductions in order to allocate a wasteload to a point source with a TMDL that also allocates expected nonpoint source load reductions" (EPA 1991). The Goose Creek TMDLs have load allocations calculated with margins of safety to meet water quality standards. The allocations; however, are based on estimates that have used available data and information. Therefore, monitoring for the collection of new data is necessary and required. For the Goose Creek TMDLs the reasonable assurance that it will meet its goal of water quality standards is based on two components: 1) nonpoint source implementation of BMPs based on land management agencies' assurance that reductions will occur, and 2) trend monitoring that will be used to document relative changes in various aquatic organism populations and in physical and chemical water quality parameters over a 10-year period in conjunction with data from various agencies, organizations, and water user industries that will assess overall progress towards attainment of water quality standards and related beneficial uses.

Responsible Parties

Development of the final implementation plan for the Goose Creek Subbasin TMDLs will proceed under the existing practice established for the state of Idaho. The plan will be cooperatively developed by DEQ, the Goose Creek committee of the Lake Walcott WAG, the affected private landowners, and other "designated agencies" with input from the established public process. Of the four entities, the WAG committee will act as the integral part of the implementation planning process to identify appropriate implementation measures. Other individuals may also be identified to assist in the development of the site-specific implementation plans as their areas of expertise are identified as beneficial to the process.

Designated state agencies are responsible for assisting with preparation of specific implementation plans, particularly for those sources for which they have regulatory authority or programmatic responsibilities. Idaho's designated state management agencies are:

- Idaho Department of Lands (IDL): timber harvest, oil and gas exploration and development, mining.
- Idaho Soil Conservation Commission (ISCC): grazing and agriculture.
- Idaho Department of Transportation (IDT): public roads.
- Idaho Department of Agriculture (IDA): aquaculture, animal feeding operations (AFOs), CAFOs.
- Department of Environmental Quality: all other activities.

To the maximum extent possible, the implementation plan will be developed with the participation of federal partners and land management agencies (i.e., NRCS, USFS, BLM, U.S. Bureau of Reclamation, etc.). In Idaho, these agencies, and their federal and state partners, are charged by the CWA to lend available technical assistance and other appropriate support to local efforts/projects for water quality improvements.
All stakeholders in the Goose Creek Subbasin have a responsibility for implementing the TMDL. DEQ and the "designated agencies" in Idaho have primary responsibility for

overseeing implementation in cooperation with landowners and managers. Their general responsibilities are outlined below.

- DEQ will oversee and track overall progress on the specific implementation plan and monitor the watershed response. DEQ will also work with local governments on urban/suburban issues.
- IDL will maintain and update approved BMPs for forest practices and mining. IDL is responsible for ensuring use of appropriate BMPs on state and private lands.
- ISCC, working in cooperation with local Soil and Water Conservation Districts, IDA, and the NRCS, will provide technical assistance to agricultural landowners. These agencies will help landowners design BMP systems appropriate for their properties, and identify and seek appropriate cost-share funds. They also will provide periodic project reviews to ensure BMPs are working effectively.
- IDT will be responsible for ensuring appropriate BMPs are used for construction and maintenance of public roads.
- IDA will be responsible for working with aquaculture to install appropriate pollutant control measures. Under a memorandum of understanding with EPA and DEQ, IDA also inspects AFOs, CAFOs, and dairies to ensure compliance with NPDES requirements.

The designated agencies, WAG, and other appropriate public process participants are expected to:

- Develop BMPs to achieve Las.
- Give reasonable assurance that management measures will meet LAs through both quantitative and qualitative analyses of management measures.
- Adhere to measurable milestones for progress.
- Develop a timeline for implementation, with reference to costs and funding.
- Develop a monitoring plan to determine if BMPs are being implemented, individual BMPs are effective, LA and WLA are being met, and water quality standards are being met.

In addition to the designated agencies, the public, through the WAG and other equivalent processes, will be provided with opportunities to be involved in developing the implementation plan to the maximum extent practical. Public participation will significantly affect public acceptance of the document and the proposed control actions. Stakeholders (landowners, local governing authorities, taxpayers, industries, and land managers) are the most educated regarding the pollutant sources and will be called upon to help identify the most appropriate control actions for each area. Experience has shown that the best and most effective implementation plans are those that are developed with substantial public cooperation and involvement.

Feedback Loop and Adaptive Management

The feedback loop is a component of the Goose Creek Subbasin TMDL strategy that provides for accountability of plan goals for various pollutants. As part of the TMDL process, the Goose Creek TMDLs will use adaptive management as a style and process whereby management of the watershed is initiated by the state, federal agencies, and the water user industries, then, an evaluation process will ascertain the direction in which the reductions are progressing, and, based on monitoring information collected from various agencies, organizations, and water users refine the goals, targets, and BMPs based on short-term and long-term objectives for ecosystem management of the Goose Creek watershed. Past management experiences may be used to evaluate both success and failure and to explore new management options where necessary. By learning from both successes and failures, the Goose Creek TMDL will be iterative to allow implementation of those techniques which may be most useful and helpful, as well as gain insights into which practices best promote recovery for restoration of beneficial uses and state water quality standards (Williams et al. 1997).

For the Goose Creek Subbasin the main goal is to reach the preliminary in-stream water quality target of 576 col/100 ml *E. coli* for all tributaries and to maintain the low TSS annual mean value already existing in most of the other systems. Additionally, for the Goose Creek Subbasin an additional main goal is to reach the preliminary in-stream water quality target of 0.05 mg/L TP for the stream systems feeding Goose Creek Reservoir. These preliminary targets are set up in this way to allow for modifications in the targets over the next 10-15 years to attain beneficial uses and meet state water quality standards.

In order for the feedback loop to be successful in the Goose Creek TMDLs, a concrete mechanism has to be designed with short-term and long-term goals for DEQ, other agencies, and the Goose Creek citizen groups. These entities must regularly review the implementation progress and monitoring results and evaluate plan effectiveness. Sufficient flexibility in management plans must be incorporated to allow for corrections in management strategies that may not be effective in achieving beneficial uses or state water quality standards. Nonpoint source industries will follow the feedback loop by: 1) identifying critical water quality parameter(s), 2) developing site-specific BMPs, 3) applying and monitoring BMPs, and 4) evaluating effectiveness of BMPs by comparing established water quality standards, and 5) modifying the BMPs where needed to achieve water quality goals.

DEQ will review all monitoring results and will provide an opportunity for the Goose Creek residents and EPA to review and comment on them. Each industry should provide summary review/reports to DEQ on its monitoring efforts, strategies, and on-going reduction mechanisms. Each industry should provide its own data in its reports. Based on these reports and other data, the Goose Creek Subbasin TMDL will be revised accordingly as an iterative plan. All industry plans will also be iterative and further developed through adaptive management as new knowledge and technology are discovered for pollution reduction efforts.

Additionally, because of the diverse nature of the partnerships and commitments within the Goose Creek Subbasin citizen groups from various agencies, organizations, and water users, both restoration and education efforts will be guided by DEQ via the Soil Conservation Districts. The citizen groups will take advantage of partner technical knowledge, experience, existing management plans, and resources in determining which types of activities are appropriate for continued implementation of the Goose Creek Subbasin TMDL. The Goose

Creek committee of the Lake Walcott WAG will continue to meet as needed. If needed, a technical advisory committee may be developed through the Soil Conservation District and DEQ. As a result, the citizen groups will have available to them the technical expertise of biologists, hydrologists, range conservationists, foresters, and other water quality and watershed specialists. Monitoring done by the various agencies, organizations, and water users will be evaluated by DEQ, the technical advisory committee, and citizen groups as a feedback mechanism. This will provide he citizens of the Goose Creek Subbasin an evaluation that is scientifically based with an understanding of local constraints. Through such adaptive management, scientific knowledge will be adapted to the task of watershed restoration by the residents of the subbasin almost immediately.

Monitoring and Evaluation

The objectives of a monitoring effort are to demonstrate long-term recovery, better understand natural variability, track implementation of projects and BMPs, and track effectiveness of TMDL implementation. This monitoring and feedback mechanism is a major component of the "reasonable assurance of implementation" for the TMDL implementation plan.

The implementation plan will be tracked by accounting for the numbers, types, and locations of projects, BMPs, educational activities, or other actions taken to improve or protect water quality. The mechanism for tracking specific implementation efforts will be reports to be submitted to DEQ.

The "monitoring and evaluation" component has two basic categories:

- Tracking the implementation progress of specific implementation plans; and
- Tracking the progress of improving water quality through monitoring physical, chemical, and biological parameters.

Monitoring plans will provide information on progress being made toward achieving TMDL allocations and achieving water quality standards and will help in the interim evaluation of progress as described under the adaptive management approach.

Implementation plan monitoring has two major components:

- Watershed monitoring and
- BMP monitoring.

While DEQ has the primary responsibility for watershed monitoring, other agencies and entities have shown an interest in such monitoring. In these instances, data sharing is encouraged. The designated agencies have primary responsibility for BMP monitoring.

Watershed Monitoring

Watershed monitoring measures the success of the implementation measures in accomplishing the overall TMDL goals and includes both in-stream and in-river monitoring. Monitoring of BMPs measures the success of individual pollutant reduction projects.

Implementation plan monitoring will also supplement the watershed information available during the development of associated TMDLs and will fill data gaps.

In the Goose Creek Subbasin TMDLs, watershed monitoring has the following objectives:

- Evaluate watershed pollutant sources,
- Refine baseline conditions and pollutant loading,
- Evaluate trends in water quality data,
- Evaluate the collective effectiveness of implementation actions in reducing pollutant loadings, and
- Gather information and fill data gaps to more accurately determine pollutant loading.

BMP/Project Effectiveness Monitoring

Site or BMP-specific monitoring may be included as part of specific treatment projects if determined appropriate and justified and will be the responsibility of the designated project manager or grant recipient. The objective of an individual project monitoring plan is to verify that BMPs are properly used and maintained and are working as designed. Monitoring for pollutant reductions at individual projects typically consists of spot checks, annual reviews, and evaluation of advancement toward reduction goals. The results of these reviews can be used to recommend or discourage similar projects in the future and to identify specific watersheds or reaches that are particularly ripe for improvement.

Evaluation of Efforts over Time

Reports on progress toward TMDL implementation will be prepared to provide the basis for the assessment and evaluation of progress. Documentation of TMDL implementation activities, actual pollutant reduction effectiveness, and projected load reductions for planned actions will be included. If water quality goals are being met, or if trend analyses show that implementation activities are resulting in benefits that indicate that water quality objectives will be met in a reasonable period of time, then implementation of the plan will continue. If monitoring or analyses show that water quality goals are not being met, the TMDL implementation plan will be revised to include modified objectives and a new strategy for implementation activities.

Implementation Time Frame

The implementation plan must demonstrate a strategy (Table 36) for implementing and maintaining the plan and the resulting water quality improvements over the long term. The timeline should be as specific as possible and should include a schedule for BMP use and/or evaluation, monitoring, reporting dates, and milestones for evaluating progress. There may be disparity in timelines for different subwatersheds. This is acceptable as long as there is reasonable assurance that milestones will be achieved.

The implementation plan will be designed to reduce pollutant loads from sources to meet TMDLs and water quality standards. DEQ recognizes that where implementation involves significant restoration, water quality standards may not be met for quite some time. In addition, DEQ recognizes that technology for controlling nonpoint source pollution is, in some cases, in the development stages and will likely take one or more iterations to develop effective techniques.

A definitive timeline for implementing the TMDL and the associated allocations will be developed as part of the implementation plan. In the meantime a compliance timeframe (Table 36) will be developed in this document as part of the implementation strategy. The implementation plan timeline will be developed in consultation with the WAG, the designated agencies, and other interested publics as the implementation plan is developed. In the interim, the timeframe outlined here will be used.

Table 36. Implementation strategy goals and time frame for nonpoint sources.

Industry	Year 1.5	Year 3	Year 10	Year 15	Year 25
Agriculture	Develop implementation plan for private lands	Begin BMP[a] implementation	Document BMP implementation progress for DEQ database	Reevaluate targets and reductions	Meet reviewed TMDL targets; beneficial uses fully supported
Grazing	Federal agencies review allotment management plans	Begin allotment management adjustments as necessary	Document BMP implementation progress for DEQ database	Reevaluate targets and reductions	Meet reviewed TMDL targets; beneficial uses fully supported
DEQ	Maintain database; review nonpoint source efficacy data; seek funding	Collect data to determine water quality trends	Collect data to determine water quality trend, BMP effectiveness, and beneficial use support	Reevaluate targets and reductions, assess beneficial uses	Collect data to determine water quality trend, BMP effectiveness, and beneficial use support

[a] BMP = Best management practice.

5.6 Conclusions

The Goose Creek SBA and TMDL analysis has been developed to comply with Idaho's TMDL schedule. The SBA describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Goose Creek Subbasin located in south central Idaho. The first part of this document, the SBA, is an important first step in leading to the actual development of TMDLs or pollution budgets for the water quality limited streams of the subbasin. The starting point for this assessment was Idaho's current 1998 §303(d) list of water quality limited water bodies. Nine segments in the Goose Creek Subbasin were on this list. However, there were 22 water body pollutant combinations. In addition, three additional water bodies were assessed due to bacterial contamination data collected in the past. These water bodies were Emery Creek, Little

Cottonwood Creek, and Left Hand Fork Beaverdam Creek. The total number of potential TMDLs was 25. The SBA portion of this document examined the current status of all of these waters, and defined the extent of impairment and causes of water quality limitation throughout the subbasin. Sediment, nutrients, temperature, and bacteria are the listed pollutants in the subbasin. These pollutants were listed on the 1996 §303(d) listed water bodies within the subbasin. Other listed pollutants and stressors include habitat, flow, and unknown. By far the most influential stressor, as noted by the SBA, was flow alteration. In general, the impacts to the beneficial uses were determined by assessing the biological communities and the limited water chemistry data available. When these two data sets were in agreement with one another, appropriate actions, such as completing a TMDL or delisting the stream, were undertaken.

To this end, it was determined that 16 different TMDLs should be completed. Of the original listed water bodies DEQ proposes to delist four of the nine. These include Lower Goose Creek Reservoir, Mill Creek, Blue Hill Creek, and Big Cottonwood Creek. Of the three additional streams assessed it was determined that Emery Creek was not impaired by bacterial contamination and that all other parameters studied were of exceptional quality during the assessment phase.

Often times the beneficial uses were impacted by flow alteration, which obscured the impacts, if any, of the other pollutants on the beneficial uses. Flow and habitat alteration issues were not discussed at great length in the assessment portion due to current DEQ policy. It is DEQ policy that flow and habitat alterations are pollution, but not pollutants for receiving TMDLs. These forms of pollution will remain on the §303(d) list; however, TMDLs for these two parameters will not be completed on segments listed with altered flow or habitat as pollutants at this time.

The next phase was the development of the loading analysis or pollution budgets for the 16 different water body pollutant combinations. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards. In addition, the pollution budgets must contain discussions of background levels, MOS, and seasonallity.

The load capacity for each water body/pollutant combination was developed using the information gathered during the assessment phase. The most important part of this information was the hydrography of the stream and time of the year in which the various beneficial uses were likely to be impaired by specific pollutants. Only three streams in the subbasin have USGS gauge information available. For the remaining streams a relationship with this gauged data was developed to predict the hydrology. In all but one case the relationship was significant and included much of the variability of the data.

Another component of load capacity included targets for the different pollutants. In general, DEQ adopted targets developed in other TMDLs. For example, the Goose Creek sediment targets include percent bank stability which was presented in TMDLs from the Idaho Falls Regional Office and suspended sediment targets of 50 mg/L TSS as presented in TMDLs developed from the Twin Falls region. In addition to these sediment targets, DEQ adopted nutrient targets from guidelines and recommendations from EPA. These targets are 0.100

mg/L TP for free flowing streams and 0.050 mg/L for streams entering into a lake or reservoir. However, in the Beaverdam Creek Watershed these targets were in appropriate. Therefore an alternative target was developed specifically for the Beaverdam Creek area. Much of this development revolved around determining background in a watershed with naturally elevated TP. It was determined that the target in the Beaverdam Creek Watershed be set at 0.129 mg/L TP which is the natural background level. To many local stakeholders this may appear overly conservative. However, through the adaptive management loop the target will be reevaluated. It is likely that beneficial uses may be fully supported at concentrations greater than 0.129 mg/L. In the meantime, as we reduce from current levels, with unsupported beneficial uses, towards fully supported beneficial uses the target will be reassessed. Once beneficial uses are restored the targets will be adjusted to that value which should be at some level greater than background.

Seasonality plays a strong role in the Goose Creek Subbasin. In most cases the beneficial uses are impacted during the summer months. The pollutants typically causing the impairments are sediment, nutrients, and bacteria. The change in pollutants has a strong correlation to grazing activities in the different watersheds; although, no statistical interpretation of this correlation was made. In general, the rise in pollutants also coincided with summer base flow conditions. Therefore the load capacity and other subsequent calculations were made using summer base flow or other appropriate design flows as indicated in the state water quality standards, such as greater than 1 cfs for cold water aquatic life.

A MOS is required in the TMDL regulations of the CWA. This is to account for uncertainty in the TMDL and how that budget restores beneficial uses. In the Goose Creek Subbasin TMDLs two types of MOS were used. The first of these was an explicit margin of 10 percent. The explicit margin allows DEQ greater freedom in other aspects of the TMDL process in that the explicit MOS can be assumed rather than arduously explained at every turn. That being said, the Goose Creek Subbasin TMDLs include an implicit MOS as well. The best example of this may lie in the bacteria TMDLs' determination of background. The background levels used in these TMDLs may be slightly higher than actual background levels, as determined from other watersheds. These elevated levels reduce the available load for waste load allocations and load allocations thereby providing an implicit margin for each watershed. In future studies the actual background level may be determined, which in turn would reduce the implicit MOS.

As we move forward with implementation of the Goose Creek Subbasin TMDLs, local stakeholders and concerned publics should see the value of adaptive management. As our understanding of the water quality issues grows so should our ability to change the current TMDLs. This is especially important as the current TMDLs were based upon a limited amount of data collected in a short amount of time.

Future iterations of the Goose Creek SBA and TMDLs will include newly listed §303(d) listed water bodies. These will be added as addendum.